

CLAIMS

1. A display device comprising:
 - a first electrode;
 - a liquid crystal layer positioned under and connected to the first electrode;
 - a second electrode;
 - a switchable optical layer, having in use either a transparent state or a non transparent state and being electrically switchable between the transparent state and the non transparent state, wherein the non transparent state is a reflective state or a selectively emissive state and the switchable optical layer is positioned above and connected to the second electrode; and,
 - a third electrode positioned between the liquid crystal layer and the switchable optical layer.
2. A display device as claimed in claim 1 wherein the third electrode is shared by the liquid crystal layer and the switchable optical layer.
3. A display device as claimed in claim 2 wherein the second and third electrodes are either both pixellated or both unitary.
4. A display device as claimed in claim 1 wherein at least one of the first, second or third electrodes is pixellated and has associated pixel switches.
5. A display device as claimed in claim 1 wherein the non-transparent state of the switchable optical layer is a reflective state.
6. A display device as claimed in claim 5 wherein the switchable optical layer is arranged to be switched as a whole.
7. A display device as claimed in claim 5 wherein the first electrode is a pixellated transparent electrode comprising a plurality of distinct electrodes.

8. A display device as claimed in claim 7 further comprising pixel switches positioned above the pixellated transparent electrode, such that each one of the pixel switches is connected to one of the plurality of distinct electrodes.
9. A display device as claimed in claim 5 wherein the second and third electrodes are unitary electrodes.
10. A display device as claimed in claim 9 wherein the unitary electrodes are transparent.
11. A display device as claimed in claim 5 further comprising a first polariser positioned above the first electrode, a second polariser, crossed with the first polariser, positioned under the second electrode, and a backlight positioned under the second polariser.
12. A display device as claimed in any one of claims 5 to 11 further comprising control means arranged to vary the voltage across the switchable optical layer and to control a backlight.
13. A display device as claimed in claim 1 wherein the non-transparent state of the switchable optical layer is a selectively light emissive state.
14. A display device as claimed in claim 13 wherein the first electrode is a unitary transparent electrode.
15. A display device as claimed in claim 13 wherein the second electrode is a first pixellated electrode connected to the switchable optical layer comprising a first plurality of first distinct electrodes and the third electrode is a second pixellated electrode connected to the switchable optical layer comprising a first plurality of second distinct electrodes, wherein each one of the first distinct electrodes opposes an associated second distinct electrode across the switchable optical layer.

16. A display device as claimed in claim 15 further comprising pixel switches positioned below the second electrode, such that each pixel switch is connected to one of the plurality of first distinct electrodes.

17. A display device as claimed in claim 13 wherein the third electrode is transparent.

18. A display device as claimed in claim 13 wherein the second electrode is reflective.

19. A display device as claimed in claim 15 further comprising control means arranged, in a first mode, to maintain the second distinct electrodes of the third electrode at the same voltage and, in a second mode, to maintain each second distinct electrode of the third electrode at the same voltage as its associated first electrode of the second electrode.

20. A mobile device comprising a power supply and a display device, as claimed in claim 1.

21. A method of controlling a display device comprising a liquid crystal layer and an underlying transparent/reflective layer which is either uniformly transparent or uniformly reflective, to operate in a first mode by:

selectively controlling portions of the liquid crystal layer and

uniformly maintaining the transparent/reflective layer in a transparent state, and

to operate in a second mode by:

selectively controlling portions of the liquid crystal layer and

uniformly maintaining the transparent/reflective layer in a reflective state.

22. A method of controlling a display device comprising a liquid crystal layer and an underlying transparent/emissive layer which is selectively either transparent or emissive, to operate in a transmissive mode by:

selectively controlling portions of the liquid crystal layer and
uniformly maintaining the transparent/emissive layer in a transparent
state, and

to operate in an emissive mode by:

uniformly controlling the liquid crystal layer and
selectively enabling portions of the transparent/emissive layer so that
the selected portions emit light.

23. A display device comprising:

a first electrode;

a liquid crystal layer positioned under and connected to the first
electrode;

a second electrode;

a switchable optical layer, having in use either a transparent state or a
non transparent state and being electrically switchable between the
transparent state and the non transparent state, wherein the non transparent
state is a reflective state and the switchable optical layer is positioned above
and connected to the second electrode; and,

a third electrode positioned between the liquid crystal layer and the
switchable optical layer.

24. A display device comprising:

a first electrode;

a liquid crystal layer positioned under and connected to the first
electrode;

a second electrode;

a switchable optical layer, having in use either a transparent state or a
non transparent state and being electrically switchable between the
transparent state and the non transparent state, wherein the non transparent
state is a selectively emissive state and the switchable optical layer is
positioned above and connected to the second electrode; and,

a third electrode positioned between the liquid crystal layer and the
switchable optical layer.